

March 1993

# 54AC/74AC378 Parallel D Register with Enable

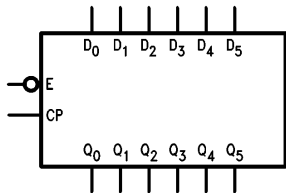
## General Description

The 'AC378 is a 6-bit register with a buffered common Enable. This device is similar to the 'AC174, but with common Enable rather than common Master Reset.

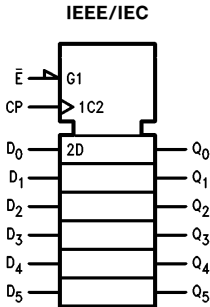
## Features

- 6-bit high-speed parallel register
- Positive edge-triggered D-type inputs
- Fully buffered common clock and enable inputs
- Input clamp diodes limit high-speed termination effects
- Standard Military Drawing (SMD)  
— 'AC378: 5962-91605

## Logic Symbols

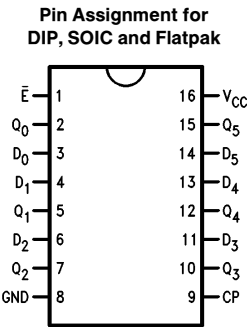


TL/F/10231-1

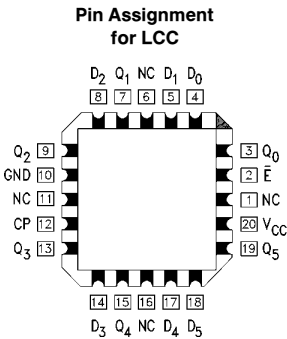


TL/F/10231-4

## Connection Diagrams



TL/F/10231-2



TL/F/10231-3

Pin Names	Description
$\bar{E}$	Enable Input (Active LOW)
D <sub>0</sub> -D <sub>5</sub>	Data Inputs
CP	Clock Pulse Input (Active Rising Edge)
Q <sub>0</sub> -Q <sub>5</sub>	Outputs

FACT™ is a trademark of National Semiconductor Corporation.

## Functional Description

The 'AC378 consists of six edge-triggered D-type flip-flops with individual D inputs and Q inputs. The Clock (CP) and Enable ( $\bar{E}$ ) inputs are common to all flip-flops.

When the  $\bar{E}$  input is LOW, new data is entered into the register on the LOW-to-HIGH transition of the CP input. When the  $\bar{E}$  input is HIGH the register will retain the present data independent of the CP input.

## Truth Table

Inputs			Output
$\bar{E}$	CP	$D_n$	$Q_n$
H	—	X	No Change
L	—	H	H
L	—	L	L

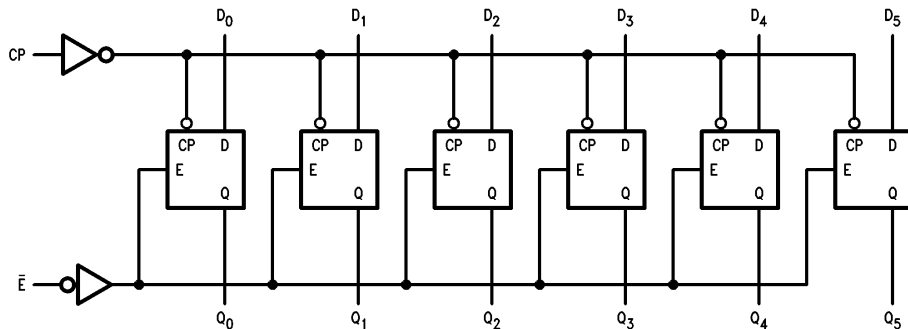
H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial

— = LOW-to-HIGH Clock Transition

## Logic Diagram



TL/F/10231-5

Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

## Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage ( $V_{CC}$ )	−0.5V to +7.0V
DC Input Diode Current ( $I_{IK}$ )	−20 mA
$V_I = -0.5V$	−20 mA
$V_I = V_{CC} + 0.5V$	+20 mA
DC Input Voltage ( $V_I$ )	−0.5V to $V_{CC} + 0.5V$
DC Output Diode Current ( $I_{OK}$ )	−20 mA
$V_O = -0.5V$	−20 mA
$V_O = V_{CC} + 0.5V$	+20 mA
DC Output Voltage ( $V_O$ )	−0.5V to $V_{CC} + 0.5V$
DC Output Source or Sink Current ( $I_O$ )	±50 mA
DC $V_{CC}$ or Ground Current per Output Pin ( $I_{CC}$ or $I_{GND}$ )	±50 mA
Storage Temperature ( $T_{STG}$ )	−65°C to +150°C
Junction Temperature ( $T_J$ )	
CDIP	175°C
PDIP	140°C

**Note 1:** Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation of FACT™ circuits outside databook specifications.

## Recommended Operating Conditions

Supply Voltage ( $V_{CC}$ )	2.0V to 6.0V
'AC	
Input Voltage ( $V_I$ )	0V to $V_{CC}$
Output Voltage ( $V_O$ )	0V to $V_{CC}$
Operating Temperature ( $T_A$ )	
74AC	−40°C to +85°C
54AC	−55°C to +125°C
Minimum Input Edge Rate ( $\Delta V/\Delta t$ )	
'AC Devices	
$V_{IN}$ from 30% to 70% of $V_{CC}$	
$V_{CC}$ @ 3.3V, 4.5V, 5.5V	125 mV/ns

## DC Characteristics for 'AC Family Devices

Symbol	Parameter	V <sub>CC</sub> (V)	74AC		54AC	74AC	Units	Conditions
			T <sub>A</sub> = +25°C		T <sub>A</sub> = −55°C to +125°C	T <sub>A</sub> = −40°C to +85°C		
			Typ	Guaranteed Limits				
V <sub>IH</sub>	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1	2.1	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> − 0.1V
		4.5	2.25	3.15	3.15	3.15		
		5.5	2.75	3.85	3.85	3.85		
V <sub>IL</sub>	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9	0.9	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> − 0.1V
		4.5	2.25	1.35	1.35	1.35		
		5.5	2.75	1.65	1.65	1.65		
V <sub>OH</sub>	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9	2.9	V	I <sub>OUT</sub> = −50 μA
		4.5	4.49	4.4	4.4	4.4		
		5.5	5.49	5.4	5.4	5.4		
		3.0		2.56	2.4	2.46	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> −12 mA I <sub>OH</sub> −24 mA −24 mA
		4.5		3.86	3.7	3.76		
		5.5		4.86	4.7	4.76		
V <sub>OL</sub>	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	0.1	V	I <sub>OUT</sub> = 50 μA
		4.5	0.001	0.1	0.1	0.1		
		5.5	0.001	0.1	0.1	0.1		
		3.0		0.36	0.5	0.44	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> 12 mA I <sub>OL</sub> 24 mA 24 mA
		4.5		0.36	0.5	0.44		
		5.5		0.36	0.5	0.44		
I <sub>IN</sub>	Maximum Input Leakage Current	5.5		±0.1	±1.0	±1.0	μA	V <sub>I</sub> = V <sub>CC</sub> , GND

\*All outputs loaded; thresholds on input associated with output under test.

## DC Characteristics for 'AC Family Devices (Continued)

Symbol	Parameter	V <sub>CC</sub> (V)	74AC		54AC		74AC		Units	Conditions
			T <sub>A</sub> = + 25°C		T <sub>A</sub> = − 55°C to + 125°C		T <sub>A</sub> = − 40°C to + 85°C			
			Typ	Guaranteed Limits						
I <sub>OLD</sub>	†Minimum Dynamic Output Current	5.5			50		75		mA	V <sub>OLD</sub> = 1.65V Max
I <sub>OHD</sub>		5.5			− 50		− 75		mA	V <sub>OHD</sub> = 3.85V Min
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5		4.0	80.0		40.0		μA	V <sub>IN</sub> = V <sub>CC</sub> or GND

†Maximum test duration 2.0 ms, one output loaded at a time.

**Note:** I<sub>IN</sub> and I<sub>CC</sub> @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V<sub>CC</sub>.  
I<sub>CC</sub> for 54AC @ 25°C is identical to 74AC @ 25°C.

## AC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> * (V)	74AC			54AC		74AC		Units
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = −55°C to +125°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = −40°C to +85°C C <sub>L</sub> = 50 pF		
			Min	Typ	Max	Min	Max	Min	Max	
f <sub>max</sub>	Maximum Clock Frequency	3.3 5.0	125 160	160 200		95 95		110 145		MHz
t <sub>PLH</sub>	Propagation Delay CP to Q <sub>n</sub>	3.3 5.0	2.5 1.5	8.5 6.0	11.0 8.0	1.5 1.5	12.0 9.0	2.5 1.5	12.5 9.0	ns
t <sub>PHL</sub>	Propagation Delay CP to Q <sub>n</sub>	3.3 5.0	2.5 1.5	8.0 5.5	10.5 7.5	1.5 1.5	12.0 9.0	2.5 1.5	11.0 8.0	ns

\*Voltage Range 3.3 is 3.3V ±0.3V  
Voltage Range 5.0 is 5.0V ±0.5V

## AC Operating Requirements

Symbol	Parameter	V <sub>CC</sub> * (V)	74AC		54AC	74AC	Units
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = −55°C to +125°C C <sub>L</sub> = 50 pF	T <sub>A</sub> = −40°C to +85°C C <sub>L</sub> = 50 pF	
			Typ	Guaranteed Minimum			
t <sub>s</sub>	Setup Time, HIGH or LOW D <sub>n</sub> to CP	3.3 5.0	1.5 1.0	3.0 2.0	4.0 4.0	3.5 2.5	ns
t <sub>h</sub>	Hold Time, HIGH or LOW D <sub>n</sub> to CP	3.3 5.0	1.0 1.0	2.0 2.0	4.0 4.0	2.0 2.0	ns
t <sub>s</sub>	Setup Time, HIGH or LOW, $\bar{E}$ to CP	3.3 5.0	0 0	2.0 2.0	2.5 2.5	2.0 2.0	ns
t <sub>h</sub>	Hold Time, HIGH or LOW, $\bar{E}$ to CP	3.3 5.0	1.0 1.0	2.0 2.0	4.0 4.0	2.0 2.0	ns
t <sub>w</sub>	CP Pulse Width HIGH or LOW	3.3 5.0	3.0 2.0	4.5 3.5	6.5 6.5	5.5 4.0	ns

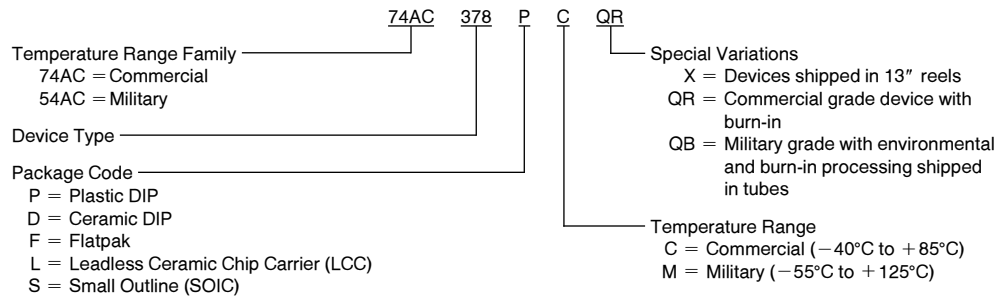
\*Voltage Range 3.3 is 3.3V ±0.3V  
Voltage Range 5.0 is 5.0V ±0.5V

## Capacitance

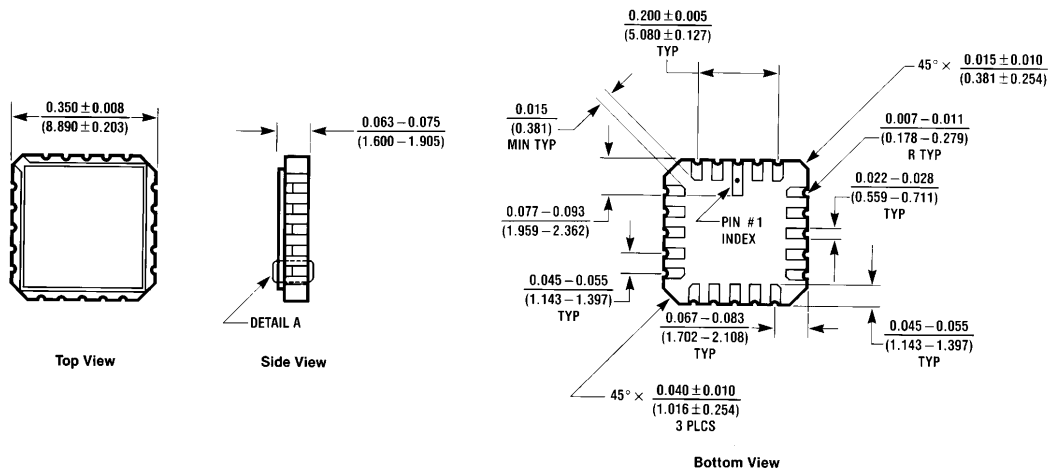
Symbol	Parameter	Typ	Units	Conditions
C <sub>IN</sub>	Input Capacitance	4.5	pF	V <sub>CC</sub> = OPEN
C <sub>PD</sub>	Power Dissipation Capacitance	28	pF	V <sub>CC</sub> = 5.0V

## Ordering Information

The device number is used to form part of a simplified purchasing code where a package type and temperature range are defined as follows:

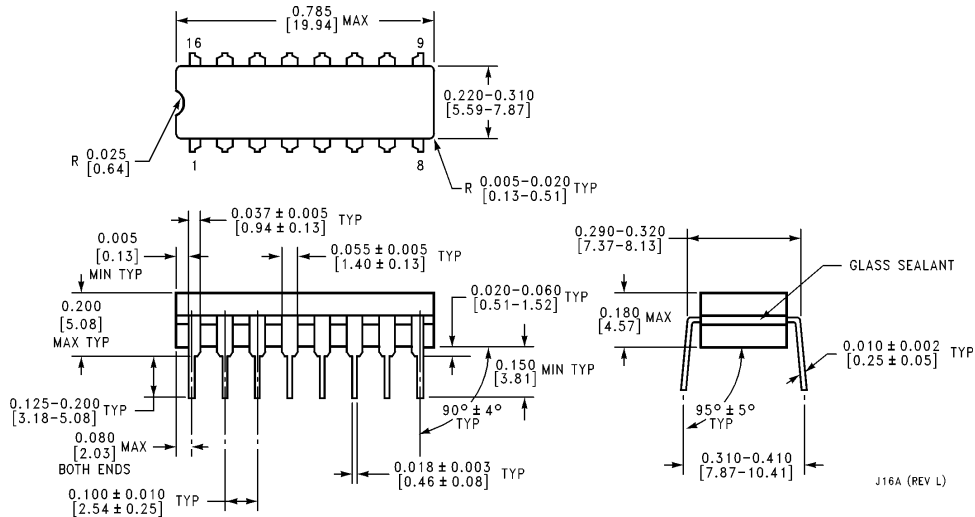


## Physical Dimensions inches (millimeters)



**20-Terminal Ceramic Leadless Chip Carrier (L)**  
**NS Package Number E20A**

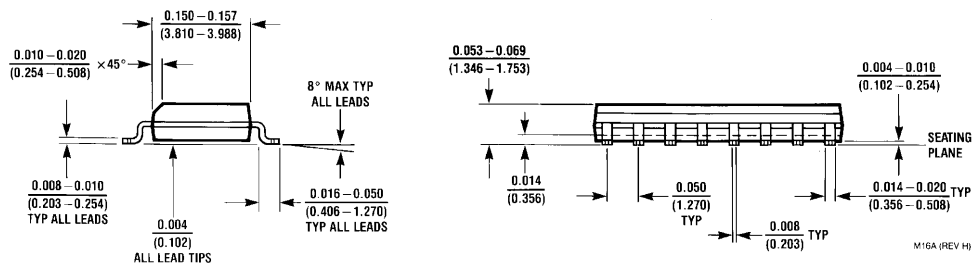
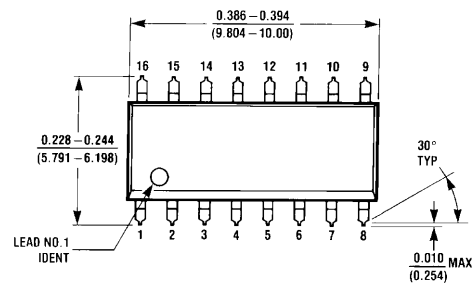
E20A (REV D)



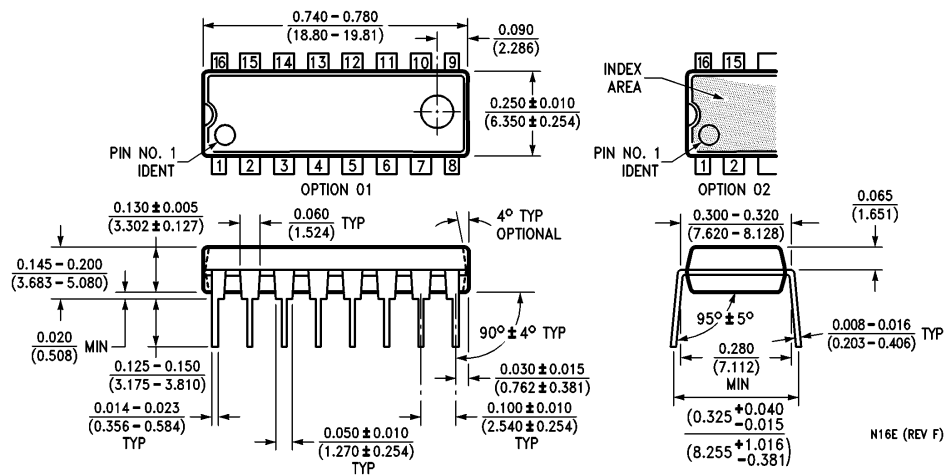
**16-Lead Ceramic Dual-In-Line Package (D)**  
**NS Package Number J16A**

J16A (REV L)

# Physical Dimensions inches (millimeters) (Continued)



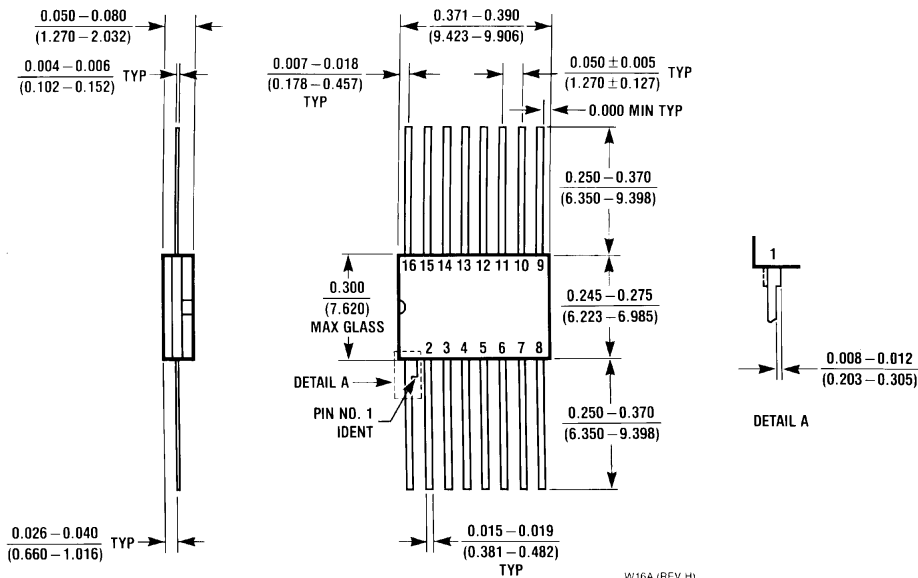
**16-Lead Small Outline Integrated Circuit (S)**  
**NS Package Number M16A**



**16-Lead Plastic Dual-In-Line Package (P)**  
**NS Package Number N16E**

**Physical Dimensions** inches (millimeters) (Continued)

Lit. # 114805



**16-Lead Ceramic Flatpak (F)**  
**NS Package Number W16A**

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



**National Semiconductor Corporation**  
 2900 Semiconductor Drive  
 P.O. Box 58090  
 Santa Clara, CA 95052-8090  
 Tel: (408) 272-9959  
 TWX: (910) 339-9240

**National Semiconductor GmbH**  
 Livny-Gargan-Str. 10  
 D-82256 Fürstentfeldbruck  
 Germany  
 Tel: (81-41) 35-0  
 Telex: 527849  
 Fax: (81-41) 35-1

**National Semiconductor Japan Ltd.**  
 Sumitomo Chemical  
 Engineering Center  
 Bldg. 7F  
 1-7-1, Nakase, Mihama-Ku  
 Chiba-City,  
 Chiba Prefecture 261  
 Tel: (043) 299-2300  
 Fax: (043) 299-2500

**National Semiconductor Hong Kong Ltd.**  
 13th Floor, Straight Block,  
 Ocean Centre, 5 Canton Rd.  
 Tsimshatsui, Kowloon  
 Hong Kong  
 Tel: (852) 2737-1600  
 Fax: (852) 2736-9960

**National Semicondutores Do Brasil Ltda.**  
 Rue Deputado Lacorda Franco  
 120-3A  
 Sao Paulo-SP  
 Brazil 05418-000  
 Tel: (55-11) 212-5066  
 Telex: 391-1131931 NSBR BR  
 Fax: (55-11) 212-1181

**National Semiconductor (Australia) Pty. Ltd.**  
 Building 16  
 Business Park Drive  
 Monash Business Park  
 Nottingham, Melbourne  
 Victoria 3168 Australia  
 Tel: (3) 558-9999  
 Fax: (3) 558-9998

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.